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THE *SOLIDAGO CANADENSIS* (ASTERACEAE: ASTEREAE) COMPLEX IN TEXAS WITH A NEW SPECIES FROM TEXAS AND MÉXICO

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ABSTRACT

Each of the three taxa of the *Solidago canadensis* complex that occur in Texas has a distinct geographic range almost completely allopatric with the others. *Solidago altissima* var. *altissima* is restricted to eastern Texas; *S. altissima* var. *gilvocanescens* (as provisionally treated here) mostly occurs in the Texas panhandle and west Texas plains, extending south through New Mexico to Culberson and El Paso counties, Texas. The taxon previously known as *S. canadensis* var. *canescens* (*S. altissima* var. *canescens*), which occurs from the Edwards Plateau to the trans-Pecos region and Coahuila and Chihuahua of adjacent northern México, is morphologically distinct from both varieties of *S. altissima* and is here redescribed and retypified at the specific rank as **S. juliae**, *spec. nov.* The first chromosome number reports for this taxon (n=9 pairs) are presented. Descriptions are provided for each of the three taxa recognized and a key summarizes the differences among them.

KEY WORDS: *Solidago*, Asteraceae, Astereae, Texas, México.

In connection with taxonomic studies of the Compositae of both México and Texas, the following observations are presented on plants of those areas known as the "*Solidago canadensis* L. complex" (Croat 1972; Melville & Morton 1982; Semple, *et al.* 1984). These are generally tall plants with pubescent stems, 3 nerved, lanceolate leaves, and secund heads in a large, pyramidal capitulescences with at least the lower branches ascending to recurved.

In their useful treatment of *Solidago* from Texas and Oklahoma, Taylor & Taylor (1984) recognized the occurrence in Texas of four varieties of *S. canadensis*: var. *gilvocanescens* Rydb., var. *hargeri* Fern., var. *salebrosa* (Piper) Jones and var. *scabra* Torr. & Gray. They provided generalized descriptions of the geographic distributions of these taxa but made no distinctions among them on their single distribution map for the species. In the present study, I recognize in Texas var. *scabra* (as *S. altissima* var. *altissima*), var. *gilvocanescens* (as *S. altissima* var. *gilvocanescens*). and an additional taxon not

among the four treated by Taylor & Taylor. In my view, var. *salebrosa* and var. *hargeri* (both *sensu* Taylor & Taylor) do not occur in Texas; further comments on the latter two taxa are found in the text below.

Solidago altissima L., Sp. Pl. 878. 1753. var. *altissima*.

S. canadensis var. *scabra* (Mühl.) Torr. & Gray, Fl. N. Amer. 2:224. 1842.

S. altissima var. *pluricephala* M.C. Johnston, Southw. Naturalist 14:372. 1970.

Plants 2-20(-30) dm tall, propagating by slender rhizomes. Stems moderately to densely spreading puberulent to short pilosulous. Leaves thick, ovate-lanceolate, 3 nerved, 5-11 cm long, 9-18 mm wide, (3-)4-7(-10) times longer than wide. usually sharply reduced in size immediately below and within the capitulescence, the upper surface sparsely scabrous, distinctly darker green, often rugulose and often somewhat shiny, moderately pilosulous, at least on the veins, and lighter colored beneath, the margins revolute, almost always with 5-10 pairs of shallow but sharp teeth on the distal 2/3. Heads secund on a large, pyramidal to ovoid capitulescence; inner phyllaries (2.8-)3.4-4.0 mm long. Ray flowers 9-14, the corollas 3.8-5.0 mm long. Disc flowers (2-)3-5, the corollas 3.0-4.0 mm long. Chromosome number, $n=27$ pairs.

Widespread and common in the West Gulf Coastal Plain of the eastern third of Texas; ravines, low areas, open woods, disturbed sites; flowering August-November(-December).

This taxon is often treated as *Solidago canadensis* var. *scabra*, but in the eastern United States and Canada it is broadly sympatric with and genetically isolated from other varieties of *S. canadensis* (Melville & Morton 1982). Var. *altissima* is hexaploid ($n=27$ pairs) according to many reports from over its entire range (e.g., Croat 1972; Semple *et al.* 1984), including at least one from Texas (Beaudry 1963). Both Melville & Morton (1982) and Semple *et al.* (1984) have recognized *S. altissima* as a species distinct from *S. canadensis* and considered var. *altissima* and *S. altissima* var. *gilvocanescens* to be more closely related to each other than to any other taxa in the *S. canadensis* complex. Var. *altissima* supposedly forms intermediates with var. *gilvocanescens* (Rydb.) Semple, although this has never been unequivocally demonstrated.

The type of *Solidago altissima* var. *pluricephala* is from Cameron County, Texas, and is characterized by a large number of small heads (inner phyllaries 2.8-3.2 mm long), each with a slightly smaller than typical number (2-4) of disc flowers. *Solidago altissima* is absent from the Rio Grande plains except for Cameron Co., and all collections from there have been made from a single, small area (M.C. Johnston, personal comm.), where it is possible that they have been introduced. Small headed plants similar to these, however, occur

further northeast all along the Texas coastal region and into Louisiana. They intergrade with the more typical form for the species and formal recognition of var. *pluricephala* is not warranted. These small headed forms probably were the basis for the claim by Taylor & Taylor (1984) that *Solidago canadensis* var. *hargeri* occurs in the "eastern portion of coastal Texas." I have not seen Texas specimens that should be identified as var. *hargeri*, which appears to be restricted to the north central United States and adjacent Canada (but see comments following var. *gilvocanescens*).

South of Texas, *Solidago altissima* occurs in a relatively typical form in México from Nuevo León (in the vicinity of Monterrey) and north central Tamaulipas through Veracruz to Oaxaca. These plants have a greater number of disc flowers ([5-]6-7) than those in Texas, but they are unquestionably the same species.

I have mapped plants from prairies in Denton and Grayson counties as *Solidago altissima*, but in that area the leaves are slightly broader with barely revolute margins and the hairs of the upper surface are thinner and longer, suggesting that they may be var. *gilvocanescens* or forms intergrading with that taxon.

Solidago altissima L. var. *gilvocanescens* (Rydb.) Semple, Phytologia 58:430. 1985. *S. canadensis* var. *gilvocanescens* Rydb., Contr. U.S. Natl. Herb. 3:182. 1895. *S. gilvocanescens* (Rydb.) Smyth, Trans. Kansas Acad. Sci. 16:61. 1899.

Plants mostly 9-16 dm tall, propagating by slender rhizomes. Stems moderately to densely puberulent with upcurved, or less commonly, straight hairs. Leaves at mid stem ovate-lanceolate, relatively thin textured, the margins not revolute, entire to shallowly or coarsely serrate, 8-13 cm long, (8-)11-20 mm wide, 6-9 times longer than wide, the upper surfaces with thin based, ascending-appressed hairs, lower surfaces more or less evenly hispid-pilose, more densely hairy than the upper surfaces. Phyllaries lanceolate, strongly graduated, the inner 3.2-4.0 mm long. Ray flowers 10-13. Disc flowers (3-)4-6(-7), 3.2-3.8 mm long. Chromosome number, n=9, 18, 27 pairs.

Mostly along streams and rivers in open plains in the Texas Panhandle and west central plains counties, extending south through New Mexico to El Paso and Culberson counties, Texas; flowering (August-)September-November.

Taylor & Taylor (1984) also apparently treated these plants as var. *gilvocanescens*. According to the geographic distribution of the varietal taxa verbally sketched by Croat (1972), however, they would be var. *hargeri*. In contrast, both var. *hargeri* and var. *gilvocanescens* were mapped as taxa of the north central to northern Great Plains (Great Plains Flora Assoc. 1977), and neither was recognized from Texas and Oklahoma; instead, in that atlas, all the plants of the *S. canadensis* complex from these two states were referred to var.

scabra. Barkley (1986), however, noted that var. *hargeri* extends southwest to New Mexico. Clearly, the taxonomic status of the Texas Panhandle plants related to *Solidago altissima* is not resolved, but I follow recent precedent in provisionally referring to them as var. *gilvocanescens*, although to emphasize the close similarity to *S. altissima*, I have used the combination by Semple. A more definitive establishment of the correct name for these plants, as well as other varietal taxa, awaits a much needed study of the whole *S. canadensis* complex.

The difference between var. *altissima* and var. *gilvocanescens* in Texas is subtle but real. Furthermore, plants nearly identical to this form of var. *gilvocanescens* occur throughout New Mexico and into eastern Arizona. They appear to be the most common form of the *Solidago canadensis* complex that occurs in New Mexico, although they are somewhat variable in robustness of habit and in leaf size and shape. The New Mexico and Arizona plants differ from those in Texas only in the number of flowers per head, with the disc flowers ranging up to 8 and the rays ranging both higher and lower in number (7-15). Although this taxon might be expected in northern Chihuahua, I have seen no collections of it from México.

Solidago altissima var. *gilvocanescens* from the north central United States has been reported both as diploid and tetraploid (Semple *et al.* 1984), and it is especially noteworthy that three hexaploid populations of what I refer to here as var. *gilvocanescens* were reported by Ward & Spellenberg (1986 [as var. *scabra*]) from southeastern New Mexico. This emphasizes the similarity between var. *altissima* and var. *gilvocanescens* in the southwestern central United States. Further chromosome counts will be critical in deciphering the pattern of variation among the variants of *S. altissima.*

The plants of a population system of *Solidago* in McKittrick Canyon of Culberson Co., Texas, and in adjacent Eddy Co., New Mexico, are included with var. *gilvocanescens* although their leaves are more narrowly lanceolate than typical, the upper leaf surfaces slightly more hairy, and the heads with slightly more flowers (rays 11-15, discs 5-8). The stem and leaf pubescence, however, is much more similar to that of var. *gilvocanescens* than to any other possible relative. These plants are probably the basis for the record of the putative occurrence in Texas of *S. canadensis* var. *salebrosa* (Taylor & Taylor 1984), but the latter taxon is restricted primarily to the Pacific Northwest and northwest Great Plains (Keck 1959; Barkley 1986), and I find no evidence for its existence in west Texas. The diploid chromosome count reported for var. *salebrosa* from Nuevo León, México (Ward & Spellenberg 1988) is from a local form of *S. missouriensis* Nutt.

A NEW SPECIES FROM TEXAS AND MÉXICO

Johnston (1970) correctly included in the Texas flora a taxon that he called *Solidago altissima* var. *canescens* (A. Gray) M.C. Johnston, and he observed

that it ranges from the Edwards Plateau to the trans-Pecos region. Taylor & Taylor (1984), in contrast, acknowledged its occurrence only by noting that it has been "reported from southwest Texas based on collections by Berlandier, Lindheimer, Bigelow, and from southern New Mexico by Thurber. The description of narrow, entire leaves and its range indicate this plant is most likely not a variety of *S. canadensis* but of *S. velutina* [DC.]."

My studies confirm the observations of Johnston. I recognize the existence of a distinctive taxon of *Solidago* in southwestern Texas and add northern Coahuila and northeastern Chihuahua, México, to its range (Figure 1). It is slightly continuous with var. *altissima* at the eastern extremity of its range and with var. *gilvocanescens* at the western extremity, but otherwise it is essentially allopatric with both of these taxa. There is no evidence, however, that would support its classification as a variety of *S. altissima*. There are no specimens that suggest morphological intergradation occurs between var. *canescens* and var. *altissima* where they meet along the eastern edge of the Edwards Plateau. At the western end of its range, there is variability in var. *canescens* (see comment below) suggestive of genetic input from var. *gilvocanescens* or perhaps some other species, but there is no evidence of intergradation. Further, var. *canescens* is diploid (see below) and chromosomally discontinuous from the hexaploid var. *altissima* as well as the hexaploids of var. *gilvocanescens* reported from southeastern New Mexico.

The observation by Taylor & Taylor (1984) that var. *canescens* might be a variety of *Solidago velutina* apparently stemmed from the similarity in stem pubescence between the two. Plants of the latter, however, are much smaller in stature with oblanceolate to obovate leaves, longer phyllaries and longer achenes (Nesom 1989b), and they apparently are more closely related to the *S. nemoralis* complex than to the *S. canadensis* complex. *Solidago velutina* overlaps in distribution with var. *canescens* in trans-Pecos Texas and northern México, but the former usually occurs in much drier habitats. Some collections from around Saltillo, México, suggest that hybridization occasionally may occur between the two, but certainly not to the extent one would expect if they were conspecific.

In conclusion, var. *canescens* is geographically, morphologically and chromosomally distinct from its relatives, *S. altissima* var. *altissima* and var. *gilvocanescens*, and I believe its recognition at the rank of species more adequately reflects its relationship to these taxa. Because the typification of Gray's name is somewhat problematic, and since the combination that would be created by elevating the rank of the varietal name is already occupied in *Solidago*, I have chosen to provide both a new name and a new type and paratypes (several being widely distributed) for this species.

Solidago juliae Nesom, *spec. nov.* TYPE: UNITED STATES. Texas: Kerr Co., along Guadalupe River on S side of Hwy 27, ca 1 mi E of jct with

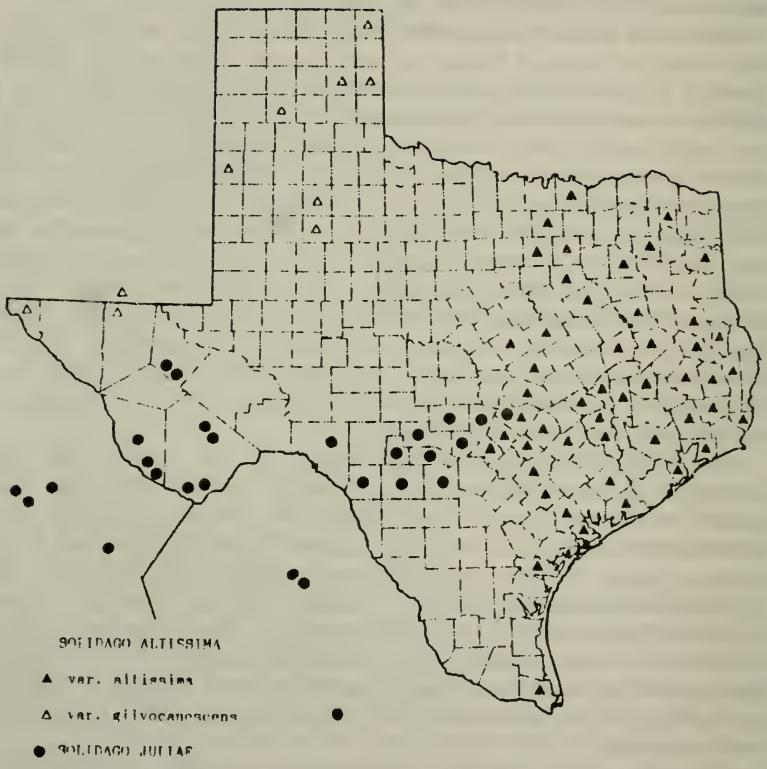

Figure 1: Distribution of the *Solidago canadensis* complex in Texas, with the complete distribution of *S. juliae*. All records except three from México are represented by specimens in LL-TEX.

Hwy 39 in Ingram, 23 Sep 1989, *Guy Nesom 7212* with Julia Nesom (HOLOTYPE: TEX; Isotypes: ANSM,ARIZ,ASU,CAS,COLO,DUR,F, GH,MEXU,MO,NCU,NMC,NY,RM,SMU,SRSC,UNM,US,WAT,WIS).

Solidago canadensis var. *canescens* A. Gray, Proc. Amer. Acad. Arts 17:197. 1882. TYPE: UNITED STATES. Southwestern Texas or southern New Mexico. Collections not cited by Gray, not seen but presumably at GH. *Solidago altissima* L. var. *canescens* (A. Gray) M.C. Johnston, Southw. Naturalist 14:372. 1970. Not *S.* (*Oligoneuron*) *canescens* (Rydb.) Friesner.

S. altissimae L. similis sed caulibus dense arcte villosi-tomentosis et foliis brevi-pilosulis utrinque pariter pubescentibus marginibus non-revolutis differt.

Plants (5-)10-25 dm tall, from short rhizomes. Stems densely, closely, and evenly villous-tomentose with very thin, whitish, crisped hairs. Leaves moderately to densely short pilose, with hairs sometimes somewhat ascending, equally pubescent above and beneath, densely arranged, lanceolate to narrowly lanceolate, the mid-cauline 5-8(-12) cm long, 5-10(-12) mm wide, (6-)7-10(-13) times longer than wide, little reduced upwards, 3 nerved, shallowly crenate or serrate to nearly entire. Heads 3.0-3.5 mm wide, secund on spreading to slightly secund branches in a large, pyramidal capitulescence; phyllaries oblong-lanceolate to oblanceolate or narrowly elliptic, with hyaline margins, glabrous or the margins apically ciliate, strongly graduated, the inner 2.8-3.5 mm long. Ray flowers 9-15, the corollas 3.0-3.2 mm long. Disc flowers 5-9, the corollas 2.8-3.0 mm long. Achenes 1.4-1.6 mm long, sparsely short strigose; pappus bristles as long as the disc corollas. Chromosome number, $n=9$ pairs.

Southwestern Texas on the southern part of the Edwards Plateau to the trans-Pecos region, northern Coahuila, and northeastern Chihuahua; along streams and lake edges, areas of grasslands to oak or oak-pine woodlands; ca 600-2200 m; flowering February-April, August-October(-November). At least in Texas and northern Coahuila, *Solidago juliae* is extremely predictable in habitat, occurring mostly in wet soil along the rocky edges of streams and rivers with permanent water. It should be expected in Hays, Comal, Bexar and Crockett counties, although there are no records from these in LL,TEX.

Additional collections examined: MÉXICO. Chihuahua: By streams near Chihuahua, 25 Sep 1885, *Pringle 338* (F,LL); valley near Chihuahua, 13 Sep 1886, *Pringle 1116* (MO); Presa Encinillas, 100 km E of Cd. Chihuahua [28° 14′ N, 104° 08′ W], 19 Oct 1974, *Rzedowski 32385* (TEX); Sta. Eulalia plains, 25 Sep 1885, *Wilkinson s.n.* (F,MU). Coahuila. Melchior Músquiz, edge of stream, 14 Oct 1963, *Latorre s.n.* (TEX); Músquiz Swamp, 15 Sep 1936, *Marsh 922* (TEX-2 sheets); 26 km E of Saltillo, Ojo Caliente, edge of pond in limestone-gypsum, 15 Aug 1979, *Wagner, et al. 4095* (MO).

UNITED STATES. Texas: Bandera Co., rocky riverbed of Sabinal River. Lost Maples Natural Area, 8 Oct 1974, *Snyder 260* (LL). Blanco Co., 6 mi S of Johnson City at jct of Hwys 290 and 281, at crossing of small creek, 29 Oct 1989, *Nesom 7219* (ANSM,ARIZ,ASU,CAS,DUR,ENCB,F,ILL,KSC,MEXU, MICH,MO,NCU,NMC,NY,RM,RSA,SMU,SRSC,SMU,TEX,UNM,US,UTC, WAT,WIS). Brewster Co.: Ridge Spring, ca 10 mi 8 of Marathon, 24 Sep 1927, *Cory 48478* (LL); 23 Sep 1938, *Cory s.n.* (TEX); 30 Jul 1938, *Warnock T547* (TEX-2 sheets); 16 Sep 1915, *Young s.*. (TEX); around spring below the ranchhouse, Old Grapevine Hills Ranch, Big Bend Natl. Park, 12 Nov 1967, *Correll & Correll 35408* (LL); Cattail Falls and along stream, Big Bend Natl. Park, 9 Nov 1964, *Correll & Correll 30585* (LL). Gillespie Co., riverbank, 1 mi N of Wolf Creek crossing on Hwy 16, ca 8 mi N of Kerrville, 23 Sep 1989, *Nesom 7211* (ANSM,MO,NY,RM,SRSC,TEX,WAT). Kendall Co., rocky riverbanks [of Cibolo Creek], Boerne, 28 Sep 1917 *Palmer 12887* (TEX) and *12888* (TEX). Kinney Co., along stream by Hwy 90, 5 mi W of Bracketville, 11 Oct 1961, *Correll & Correll 24736* (LL). Medina Co., edge of Hondo Creek, 12 mi N of Hondo, 28 Oct 1952, *Correll 15218* (LL). Presidio Co.: shallow pools in Chorro Canyon, Big Bend Ranch, 14 Jun 1975, *Butterwick & Strong 950* (TEX); vicinity of waterfall in lower Arroyo Segundo, a tributary of Fresno Creek on the Big Bend Ranch, 1 Oct 1975, *Butterwick & Lamb 1733* (TEX); between Madril Ranch and falls in upper Madera Canyon, Bofecillas Mts. on the Big Bend Ranch, 19 Oct 1972, *Chiang, Wendt & Johnston 9696* (LL); wet soil among boulders in Capote Creek Canyon, just below Capote Falls, 2 Nov 1966, *Correll 34121* (LL). Real Co., crossing of West Frio River on Hwy 83, 2 mi NE of Leakey, 23 Sep 1989, *Nesom 7213* (ANSM,ARIZ,ASU,BAYL,CAS,CIIDIR,COLO,ENCB,F,GA,ILL,MICH,MO, NCU,NLU,NY,OBI,RM,RSA,SD,SMU,TAES,TEX,UTC,WAT,WIS,WTU). Reeves Co.: 0.8 mi E of Balmorhea, 2 Nov 1934, *Cory 12080* (TEX), 28 Sep 1942, *Cory 40560* (TEX); Balmorhea, 13 Sep 1931, *Whitehouse 8472* (TEX). Travis Co., Watkins Ranch in NW corner of the county, 14 Oct 1950, *Tharp 51-495* (TEX). Uvalde Co., along Sabinal River, Utopia, 16 May 1954, *Johnston 54632* (TEX), 7 Oct 1917, *Palmer 12942* (TEX). Val Verde Co., along San Felipe Creek, near Del Rio, 8 Oct 1952, *Correll 14950* (LL); San Felipe Springs, near Del Rio, 18 Apr 1957, *Correll 15990* (LL); Del Rio, 1 Feb 1932, *Whitehouse 8471* (TEX).

The chromosome number of *Solidago juliae* is reported here for the first time. Plants from each of three populations of the southern Edwards Plateau (*Nesom 7211*-Gillespie Co., *7212*-the type from Kerr Co. and *7213*-Real Co.) showed numerous cells in late prophase and metaphase (meiosis I) with nine bivalents. Voucher specimens of these are deposited at TEX and duplicates are being distributed on exchange as noted above.

Over most of its range, *Solidago juliae* is relatively uniform in morphology. The most notable variants occur in the western part of its range. In north-

eastern Chihuahua the plants have slightly broader leaves with less pubescent upper surfaces than those in Texas and Coahuila. This perhaps is reflective of genetic input from *S. altissima* var. *gilvocanescens*, but as noted above, the latter appears to be completely absent or at least very rare in that area. In Presidio Co., the leaves of some plants are more sparsely pubescent with nearly adpressed hairs and most of the disc flowers are malformed with anthers abortive or absent. The pilose-tomentose stems and narrowly lanceolate leaves equally hairy above and below, however, place them with *S. juliae*. Finally, the collection from near Saltillo (*Wagner, et al. 4095*) is by far the southernmost for the species and has an unusually large number (20) of ray flowers.

Solidago juliae may be the progenitor of *S. gypsophila* Nesom, a narrow endemic restricted to the area of Cuatro Cienegas, Coahuila (Nesom 1989a). The latter differs in its leaves with deeply recessed lamina and strongly protruding venation, dense, evenly hispidulous-hirtellous foliar pubescence, shorter phyllaries and fewer ray and disc flowers.

KEY TO THE TAXA OF THE *SOLIDAGO CANADENSIS* COMPLEX IN TEXAS

1. Stems densely and closely villous-tomentose; leaves densely and evenly short pilose above and beneath; plants of the Edwards Plateau and trans-Pecos Texas ..... *S. juliae*

1. Stems short pilose to puberulent; leaves usually noticeably less hairy above than beneath and often darker colored above, with ascending-appressed hairs on the upper surfaces ..... (2)

    2. Leaves with prominently revolute margins, the upper surfaces with stiff, ascending-appressed trichomes consisting of mostly no more than a short apiculus extending from a thick base; plants of the eastern third of Texas ..... *S. altissima* var. *altissima*

    2. Leaves with the margins slightly thickened but not revolute, the upper surfaces with thin, elongate trichomes not strongly thickened basally; plants of the Panhandle and west central plains counties ..... *S. altissisma* var. *gilvocanescens*

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